

6 · Explosive and Whirling Nebulæ

M51 is in Canes Venatici and is about 35 million light years distant.

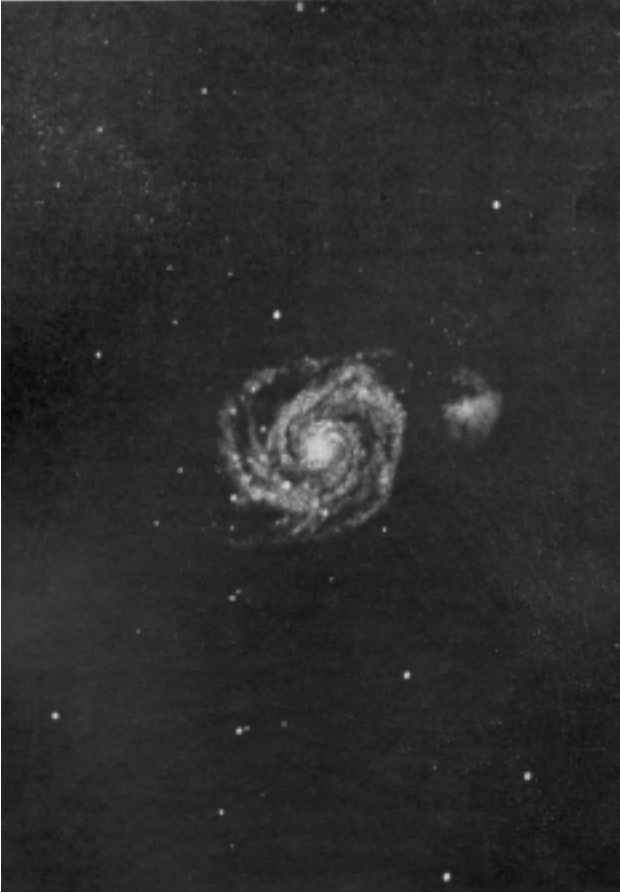
About 60% of the external galaxies are spiral; the rest are elliptical or irregular.

The planetary nebulae listed are gas shells emitted from central stars and have nothing to do with solar system formation.

ONE of the most surprising triumphs of celestial photography was Professor Keeler's discovery, in 1899, that the great majority of the nebulae have a distinctly spiral form. This form, previously known in Lord Rosse's great 'Whirlpool Nebula,' had been supposed to be exceptional; now the photographs, far excelling telescopic views in the revelation of nebular forms, showed the spiral to be the typical shape. Indeed, it is a question whether all nebulae are not to some extent spiral. The extreme importance of this discovery is shown in the effect that it has had upon hitherto prevailing views of solar and planetary evolution. For more than three-quarters of a century Laplace's celebrated hypothesis of the manner of origin of the solar system from a rotating and contracting nebula surrounding the sun had guided speculation on that subject, and had been tentatively extended to cover the evolution of systems in general. The apparent forms of some of the nebulae which the telescope had revealed were regarded, and by some are still regarded, as giving visual evidence in favor of this theory. There is a 'ring nebula' in Lyra with a central star, and a 'planetary nebula' in Gemini bearing no little resemblance to the planet Saturn with its rings, both of which appear to be practical realizations of Laplace's idea, and the elliptical rings surrounding the central condensation of the Andromeda Nebula may be cited for the same kind of proof.

But since Keeler's discovery there has been a decided turning away of speculation another way. The form of the spiral nebulae seems to be entirely inconsistent with the theory of an originally globular or disk-shaped nebula condensing around a sun and throwing or leaving off rings, to be subsequently shaped into planets. Some astronomers, indeed, now reject Laplace's hypothesis *in toto*, preferring to think that even our solar system originated from a spiral

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Lord Rosse's Nebula

nebula. Since the spiral type prevails among the existing nebulae, we must make any mechanical theory of the development of stars and planetary systems from them accord with the requirements which that form imposes. A glance at the extraordinary variations upon the spiral which Professor Keeler's photographs reveal is sufficient to convince one of the difficulty of the task of basing a general theory upon them. In truth, it is much easier to criticize Laplace's hypothesis than to invent a satisfactory substitute for it. If the spiral nebulae seem to oppose it there are other nebulae which appear to support it, and it may be that

The spiral 'nebulae' are vastly larger and farther away than the author suspects. He supposes them to be single, or at most a few, solar systems in formation. They are in fact whole galaxies containing hundreds of billions of solar systems.